

T01D04 - Percent Composition and Empirical Formula

Name _____

Directions: Show ALL work for each of the following. UNITS ARE EXTREMELY IMPORTANT.

1. How many
- grams
- of aluminum are contained in 1.35 kg of
- $\text{Al}(\text{H}_2\text{PO}_4)_3$
- ?

$$\frac{26.98 \times 1}{317.95} \times 100 = 9.43\%$$

$$1.35 \text{ kg} \times 0.943 = 0.127 \text{ kg Al}$$

$$= 127 \text{ g Al}$$

- How many
- grams
- of water can be removed from 1.55 mg of
- $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$
- ?

$$\frac{18.02 \times 6}{273.40} \times 100 = 39.5\%$$

$$1.55 \text{ mg} \times 0.395 = 0.613 \text{ mg H}_2\text{O}$$

$$6.13 \times 10^{-4} \text{ g H}_2\text{O}$$

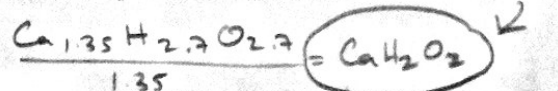
2. Determine the empirical formulas for each of the following:

- a. 54.05% calcium, 2.70% hydrogen, and 43.24% oxygen

$$54.05 \text{ g Ca} \times \frac{1 \text{ mol Ca}}{40.07 \text{ g Ca}} = 1.35 \text{ mol Ca}$$

$$43.24 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.7 \text{ mol H}$$

$$2.70 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 2.7 \text{ mol H}$$

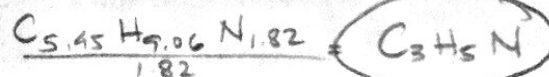


- b. 65.42% carbon, 9.15% hydrogen, and 25.43% nitrogen

$$65.42 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 5.45 \text{ mol C}$$

$$25.43 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 1.82 \text{ mol N}$$

$$9.15 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 9.06 \text{ mol H}$$



- c. 35.51% carbon, 4.77% hydrogen, 37.85% oxygen, 8.29% nitrogen and 13.60% sodium (aka MSG)

$$35.51 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 2.96 \text{ mol C}$$

$$4.77 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 4.77 \text{ mol H}$$

$$37.85 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.37 \text{ mol O}$$

$$8.29 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 0.59 \text{ mol N}$$

$$13.60 \text{ g Na} \times \frac{1 \text{ mol Na}}{22.99 \text{ g Na}} = 0.59 \text{ mol Na}$$

$$\text{C}_{2.96} \text{H}_{4.77} \text{N}_{0.59} \text{O}_{2.37} \text{Na}_{0.59} = \text{C}_5\text{H}_8\text{NNaO}_4$$

3. A compound is known to have an empirical formula of CH and a molar mass of 78.11 g/mol. What is its molecular formula?

$$\text{CH} = 13.02 \text{ g/mol}$$

$$\frac{78.11 \text{ g/mol}}{13.02 \text{ g/mol}} = 6 \times \text{CH} = \text{C}_6\text{H}_6$$

4. Another compound, also with an empirical formula of CH is found to have a molar mass of 26.04 g/mol. What is its molecular formula?

$$\text{CH} = 13.02 \text{ g/mol}$$

$$\frac{26.04 \text{ g/mol}}{13.02 \text{ g/mol}} = 2 \times \text{CH} = \text{C}_2\text{H}_2$$

5. Given the following mass percent composition, determine the empirical formula.

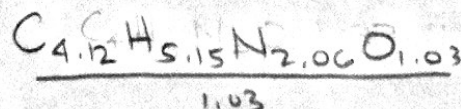
49.50% C, 5.20% H, 28.80% N, 16.50% O. What is the molecular formula for this compound if the molar mass is 194.2 g/mol?

$$49.50 \text{ g C} \times \frac{1}{12.01} = 4.12 \text{ mol C}$$

$$5.20 \text{ g H} \times \frac{1}{1.01} = 5.15 \text{ mol H}$$

$$28.80 \text{ g N} \times \frac{1}{14.01} = 2.06 \text{ mol N}$$

$$16.50 \text{ g O} \times \frac{1}{16.00} = 1.03 \text{ mol O}$$



$$\text{C}_4\text{H}_5\text{N}_2\text{O} = 97.11 \text{ g/mol}$$

$$\frac{194.2 \text{ g/mol}}{97.11 \text{ g/mol}} = 2 \Rightarrow \text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$$